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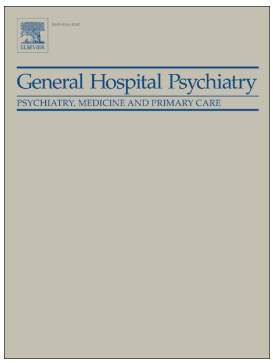

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Sedentary behavior and anxiety: association and influential factors among 42,469 community-dwelling adults in six low- and middle-income countries

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Running title: anxiety and sedentary behavior

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Abstract

Objective: This study investigated the association between sedentary behavior (SB) and anxiety, and explored factors that influence this relationship in six low- and middle-income countries.

Method: Cross-sectional data were analyzed from the World Health Organization's Study on Global Ageing and Adult Health. Multivariable linear and logistic regression analyses were conducted to assess the association between anxiety and self-reported SB. Potentially influential factors were examined with mediation analysis.

Results: The sample consisted of 42,469 adults aged ≥18 years (50.1% female; mean age 43.8 years). After adjusting for sociodemographics and country, people with anxiety engaged in 24 (95%CI=7-41) more minutes per day of SB than non-anxious individuals; the corresponding figure for the elderly (≥65 years) was much higher (55 minutes; 95% CI= 29-81). Anxiety was associated with a 2.0 (95%CI=1.5-2.7) times higher odds for high SB (i.e., ≥8h/day). Overall, the largest proportion of the high SB-anxiety relationship was explained by mobility limitations (46.8%), followed by impairments in sleep/energy (44.9%), pain/discomfort (31.7%), disability (27.0%), cognition (13.3%), and physical activity levels (6.3%).

Conclusions: Anxiety was significantly associated with high SB, particularly among older adults. Future longitudinal studies are warranted to disentangle the potentially complex interplay of factors that may influence the anxiety-SB relationship.

Key words: sedentary behavior; sitting; physical activity; anxiety; low- and middle-income countries

1. Introduction

The global prevalence of anxiety disorders in the past year ranges from 2.4% to 29.8% [1], whilst subthreshold anxiety [2] and symptoms of anxiety are also common and problematic across the lifespan [3, 4]. Anxiety disorders are the sixth leading cause of disability, in terms of years lived with disability, in both high-income countries and low- and middle-income countries (LMICs) [5]. Specifically, anxiety disorders accounted for 390 disability-adjusted life years per 100,000 persons in 2010 [5]. The burden of anxiety is further exacerbated by the high risk of co-morbid cardiovascular diseases and associated premature mortality [6, 7].

In the past decade, time spent in sedentary behavior (SB) has emerged as an important indicator of various health outcomes in adult populations [8]. SB refers to any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining or lying posture [9]. It is associated with a range of deleterious outcomes such as diabetes, cancer, cardiovascular diseases, and premature mortality, independent of physical activity [10, 11]. More recently, there has been growing interest in its relation with anxiety. For example, a recent meta-analysis, almost exclusively among high-income countries, found a positive relationship between increasing time spent sedentary or sitting and anxiety risk [12]. The most recent evidence shows significant positive associations both between self-reported screen-based sedentary time and anxiety symptoms among 528 mothers of young children [13], and between accelerometer-measured percent time spent sedentary and anxiety among 362 Japanese elementary-school children [14].

Though the mechanisms linking anxiety and SB are not fully understood, there is some evidence that SB may induce anxiety [12]. For example, a recent randomized controlled trial (RCT) reported that, when SB was experimentally increased for one week by eliminating exercise and reducing steps to ≤5000 steps/day, anxiety symptoms were significantly increased [15]. Additionally, recent evidence showed that a 30-min bout of imposed sedentary time during a cognitively-passive quiet rest condition worsened anxiety state, feelings of low energy and fatigue, and worry [16]. Moreover, a previous RCT randomizing young adults to be more sedentary showed that increasing SB over two weeks resulted in increases in inflammatory markers such as IL-6, which accompanied deteriorations in mood [17]. Thus, it may be hypothesized that some underlying inflammatory response may elicit changes in mood, given that such biomarkers are associated with mood disturbances [18]. Indeed, evidence supports that inflammatory factors may influence the positive

effects of exercise on mood outcomes [19-21], while provisional evidence suggests that standing and breaking up prolonged periods of SB can improve inflammatory biomarkers profiles [22-25]. It is plausible that reducing SB may reduce anxiety via a similar inflammatory mechanism. On the other hand, social withdrawal [26], somatic co-morbidities [27] and associated depression [28] may lead to a sedentary lifestyle in people with anxiety.

Despite the increasing literature on the SB-anxiety relationship, a number of research gaps exist. First, there are currently no nationally representative data from LMICs. To the authors' knowledge, there is only one Chinese study including 5,003 boys and girls from four junior high schools showing that exposure to SB for more than 2h/day was a risk factor for anxiety symptoms (OR=1.36, 95%CI: 1.18-1.57) [29]. The paucity of studies from LMICs is an important omission given that the mental health burden is increasing in these countries [30], coupled with an upward trend in sedentary lifestyles and non-communicable disease [31]. Second, compared to high-income countries, different socioeconomic, cultural, and environmental factors may influence the anxiety-SB relationship. Third, there is a lack of studies assessing potential sources of variability in the anxiety-SB relationship.

Thus, the current study investigated the association between anxiety and SB, and explored the extent to which various factors explained the anxiety-SB association using nationally representative data from six LMICs (China, Ghana, India, Mexico, Russia, South Africa) which collectively cover nearly half of the global population. Based on previous research, we focused on age, mobility, pain and discomfort, cognition, sleep and energy, depression, disability, physical activity, alcohol consumption, smoking, body mass index (BMI), and social cohesion as potentially influential factors in the anxiety-SB relationship for their previously reported association with anxiety and SB [32-39].

2. Methods

2.1. The survey

Data from the Study on Global Ageing and Adult Health (SAGE) survey was analyzed. The survey was conducted between 2007 and 2010 in China, Ghana, India, Mexico, Russia, and South Africa, which were all LMICs at the time of the survey according to the World Bank classification. Details of the survey methodology are provided elsewhere [40]. Briefly, in order to obtain nationally representative samples, a multi-stage clustered sampling design method was used. The sample consisted of adults aged ≥18 years with oversampling of those aged ≥50 years. Trained interviewers conducted face-to-face interviews using a standard questionnaire across countries to collect information. Standard translation procedures for the questionnaires were undertaken to ensure comparability between countries. Sampling weights were calculated to adjust for the population structure as reported by the United Nations Statistical Division. Ethical approval was obtained from the WHO Ethical Review Committee and local ethics research review boards. Written informed consent was obtained from all participants. The survey response rate ranged from 51% (Mexico) to 93% (China).

2.2. Variables

2.2.1. Sedentary behaviour (Outcome variable)

In order to assess SB, participants were asked to state the total time they usually spent (expressed in minutes per day) sitting or reclining including at work, at home, getting to and from places, or with friends (e.g., sitting at a desk, sitting with friends, travelling in car, bus, train, reading, playing cards or watching television). This did not include time spent sleeping. The variable on SB was used in the analysis as a continuous variable (minutes per day) and also as a categorical [<8 or ≥8 hours per day (high SB)] variable. The eight-hour cut-off was chosen as previous research indicated that being sedentary for ≥8 hours/day in the general population is associated with a higher risk for premature mortality [11].

2.2.2. Anxiety (Exposure variable)

Anxiety was assessed by the question ‘Overall in the past 30 days, how much of a problem did you have with worry or anxiety’ with response alternatives: none, mild, moderate, severe, and extreme. In

accordance with previous publications using a dataset with the identical question, those who answered severe and extreme were considered to have anxiety [27, 28].

2.2.3. Potential influential factors

2.2.3.1. Health status. The health status was evaluated with 10 health-related questions pertaining to four health domains including: (a) mobility; (b) pain and discomfort; (c) cognition; (d) sleep and energy. Each of the domains corresponds to those in common health related quality of life outcome measures such as the Short Form-12 (SF-12) [41], the Health Utilities Index Mark-3 (HUI) [42] and the EUROQOL-5D [43]. Each domain consists of two questions that assessed health function in the past 30 days. Each item was scored on a five-point scale ranging from 'none' to 'extreme/cannot do'. The actual questions can be found in supplementary **eTable 1**. For each separate domain, we used factor analysis with polychoric correlations to obtain a factor score which was later converted to scores ranging from 0-100 with higher values representing worse health function [44, 45].

2.2.3.2. Depression. Questions based on the World Mental Health Survey version of the Composite International Diagnostic Interview [46] were used for the endorsement of past 12-month DSM-IV depression using the same algorithm used in previous studies using the same dataset [47, 48].

2.2.3.3. Disability. Disability was assessed with six questions on the level of difficulty in conducting standard basic activities of daily living (ADL) in the past 30 days (washing whole body, getting dressed, moving around inside home, eating, getting up from lying down, and using the toilet) [49]. Those who answered severe or extreme/cannot do to any of the six questions were considered to have disability [50].

2.2.3.4. Physical activity. Levels of physical activity was assessed with the Global Physical Activity Questionnaire [51]. The total amount (min) of moderate-to-vigorous physical activity in a typical week was calculated.

2.2.3.5. *Alcohol consumption and smoking.* These consisted of current smoking (Y/N) and alcohol use

in the past 30 days (Y/N)

2.2.3.6. Body mass index (BMI). A stadiometer and a routinely calibrated electronic weighting scale were used to measure height and weight respectively. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, and categorized as <18.5 (underweight), 18.5-24.9 (normal), 25.0-29.9 (overweight), and ≥30 (obese) kg/m^2.

2.2.3.7. Social cohesion. In accordance with a previous SAGE publication [52], a social cohesion index was created based on nine questions on the participant's involvement in community activities in the past 12 months (e.g., attended religious services, club, society, union etc) with answer options 'never (coded=0)', 'once or twice per year (coded=1)', 'once or twice per month (coded=2)', 'once or twice per week (coded=3)', and 'daily (coded=4)'. The answers to these questions were summed (range 0-36) with higher scores indicating higher levels of social cohesion.

2.2.4. Control variables

These included sociodemographic variables such as sex, age, wealth, highest level of education achieved (≤primary, secondary, ≥tertiary), marital status (married/cohabiting or never married/separated/divorced/widowed), setting (urban or rural), and employment status (engaged in paid work ≥2 days in last 7 days: Y/N). Wealth quintiles were created based on country-specific income.

2.3. Statistical analysis

The statistical analysis was performed with Stata 14.1 (Stata Corp LP, College station, Texas). The difference in sample characteristics between those with and without anxiety or high SB was tested by Student's *t*-tests and Chi-squared tests for continuous and categorical variables, respectively. Multivariable logistic and linear regression analyses were used to assess the association between anxiety (exposure) and SB (outcome). The main analysis consisted of the logistic regression analysis using the binary SB variable (i.e., <8 or ≥8 hours/day) as the outcome. This analysis was intended to specifically capture the association between anxiety and high levels of SB. A secondary analysis

using linear regression with the continuous variable (min/day of SB) as the outcome was also conducted to assess changes in minutes/day engaged in SB associated with anxiety. A base model was constructed adjusting for the sociodemographic variables (i.e., sex, age, wealth, education, marital status, setting, employment status), and country.

We also conducted mediation analysis in order to assess the extent to which various factors may explain the high SB-anxiety relation, Specifically, we focused on mobility, pain and discomfort, cognition, sleep and energy, depression, disability, physical activity, alcohol consumption, smoking, BMI, and social cohesion for their previously reported association with the exposure (anxiety) and the outcome (high SB) [32-39]. Sociodemographic variables were not considered as potential influential factors as they are generally considered to be less modifiable. We used the *khb* (Karlson Holm Breen) command in Stata [53] for the mediation analysis. This method can be applied in logistic regression models and decomposes the total effect (i.e., unadjusted for the mediator) of a variable into direct (i.e., the effect of anxiety on SB adjusted for the mediator) and indirect effects (i.e., the mediational effect). Using this method, the percentage of the main association explained by the factor can also be calculated (mediated percentage). Each potential influential factor was included in the model separately. The mediation analysis controlled for the sociodemographic variables and country. The mediated percentage was only calculated in the presence of a significant indirect effect.

For the regression analyses, analyses using the overall sample and also by age groups (age 18-49, 50-64, ≥65 years) were conducted. In order to test whether the magnitude of the association between anxiety and SB by age groups is significantly different, we also included a product term (age group X anxiety) in the model. All regression analyses were also adjusted for country by including dummy variables for each country. All variables were included in the models as categorical variables with the exception of the variable on age, min/day of SB, social cohesion, health status (mobility, pain and discomfort, cognition, sleep and energy), and physical activity (continuous variables). Under 3% of the data were missing for the variables used in the current analysis with the exception of BMI (5.8%) Complete case analysis was done. The sample weighting and the complex study design were taken into account in all analyses. Results from the regression analyses are presented as odds ratios (ORs) or b-coefficients with 95% confidence intervals (CIs). The level of statistical significance was set at $P<0.05$.

3. Results

The sample consisted of 42,469 (China n=14,811; Ghana n=5108; India n=11,230; Mexico n=2742; Russia n=4355; South Africa n=4223) individuals aged ≥18 years [mean (SD) age 43.8 (14.4), 50.1% females]. The overall prevalence (95%CI) of high SB (i.e., ≥8h/day of SB) was 8.3% (7.1%-9.7%), while the mean (SD) minutes/day spent sedentary across the whole sample was 207 (149). The overall prevalence (95%CI) of anxiety was 5.7% (5.0-6.5). The prevalence of anxiety was highest among those spending ≥11 hours/day sedentary (14.5%) (see **Figure 1**). The sample characteristics are provided in **Table 1**. Older age, not being married/cohabiting, urban setting, unemployment, mobility limitations, sleep/energy disruption, and disability were characteristics strongly associated with both anxiety and high SB.

[Insert Table 1 and Figure 1 here]

In models adjusted for sociodemographics and country, anxiety was associated with a 2.0 (95%CI=1.5-2.7) times higher odds for high SB, while the mean time spent sedentary was 24.2 (95%CI=7.0-41.4) minutes longer per day among anxious individuals (**Table 2**). Estimates were comparable across age groups for high SB, but when the outcome was min/day of SB, anxiety was not associated with a higher mean time spent sedentary among those aged 18-49 years. This difference in the magnitude of the association between age groups was confirmed to be statistically significant by interaction analysis ($P<0.05$).

Table 3 and **Table 4** include the results of the mediation analysis that explored the degree to which the association between anxiety and high SB can be explained by various factors. Based on the overall sample, the largest proportion of the total effect was explained by mobility limitations (46.8%), followed by impairments in sleep/energy (44.9%), pain/discomfort (31.7%), disability (27.0%), cognition (13.3%), and physical activity (6.3%). Depression, alcohol consumption, smoking, and body mass index did not account for significant variation in the SB-anxiety relationship in the overall sample or in any of the age groups (i.e., no significant indirect effect). Social cohesion explained 9.5% of the association only among individuals aged ≥65 years. Health status and disability generally explained a larger proportion of the high SB-anxiety association among the older with the exception of

sleep/energy, which was a more important factor among those aged <50 years (explained 70.4% of the association). (**Table 4**).

[Insert tables 2, 3 and 4 about here]

In order to assist future longitudinal research to develop theoretical models of the relationship between anxiety and sedentary behavior, the Pearson correlation between the influential factors are presented in **eTable 2** (supplementary material). There was a particularly strong correlation between mobility and pain/discomfort, cognition, sleep/energy, and between pain/discomfort and sleep/energy.

4. Discussion

4.1. General findings

To the authors' knowledge, this study is the first multinational study investigating the relationship between SB and anxiety, and the first study from LMICs which uses nationally representative data. Furthermore, it is one of the very few studies which have attempted to explore the factors that influence the anxiety-SB relationship. Overall, findings showed that individuals with anxiety have a two-fold higher odds for high SB (i.e., ≥8h/day of SB), and that similar patterns are observed across the lifespan. In the entire sample, the most influential factors in this association were mobility difficulties, sleep/energy issues, pain/discomfort, and disability. Cognition and physical activity explained the association to a lesser extent. Depression, alcohol consumption, smoking, and BMI were not significant factors in the overall sample or any of the age groups. Social cohesion was a significant influential factor only among the elderly. Given the high levels of SB among those with anxiety previously reported [12], and the deleterious outcomes of high levels of SB in the general population [10], the current findings provide important insights that might help shape future longitudinal investigations and ultimately clinical interventions.

Mobility limitations, pain, and disability were particularly important factors in the SB-anxiety relationship in the elderly. These factors may influence this association in several ways. First, mobility limitations, pain, and disability may all be shared risk factors for SB [54] and anxiety [55]. Mobility problems, disability, and anxiety may also be linked through an increased risk of fall incidents [56] and fear of falling [57] which in turn are associated with a more sedentary lifestyle, particularly in older people who also experience pain [53]. Individuals with mobility difficulties, pain, or disability may also be more socially isolated due to their restrictions in ability to conduct activities of daily living or stigma [58], while social isolation has been associated with anxiety [59]. Social cohesion may be an important factor especially among the elderly as 9.5% of the anxiety-SB relationship was explained by this factor in this age group.

Additionally, findings also indicated that cognitive problems modestly influenced the relationship between SB and anxiety. Some SBs, such as TV viewing, have been linked to detrimental cognitive development in early childhood [60] and poorer cognitive function in older adults [61], while poor cognitive performance has also been associated with anxiety [62]. It might also be hypothesized that cognitive problems are related with SB and anxiety by analogy (i.e., SB and anxiety are

associated with many chronic diseases, which are also associated with cognitive impairment) [63, 64].

Interestingly, sleep and energy problems appeared to be important influential factors across all age ranges. Sleep and energy problems are found in the majority of people with anxiety and related disorders [36]. Sleep problems during the night predispose people to “napping” during the day which has been associated with other deleterious outcomes such as a poor cardio-metabolic profile [65], which in turn are again associated with SB. These findings are consistent with the available population-based evidence from adults that physical inactivity is associated with sleep complaints and feelings of low energy and fatigue, whereas physical activity is associated with better sleep quality and a reduced risk of reporting fatigue; physically active individuals, on average, have 39% reduced odds of experiencing feelings of fatigue [66, 67].

Finally, physical activity levels accounted for 6% of the association between SB and anxiety. It is known that engaging in structured physical activity (i.e., exercise training) is an effective treatment for anxiety [68]. Despite this, people with anxiety are known to engage in low levels of moderate-to-vigorous PA and are more likely to not meet the recommended PA guidelines of 150 min per week of moderate-to-vigorous PA. For example, data from 38 LMICs involving almost 185,000 participants showed that the proportion of people who do not comply with the international recommendations are higher among those with anxiety compared to those without anxiety (22.9% vs. 16.6%; $p<0.0001$) [28]. However, given that the SB-anxiety association may also be explained by shared risk factors such as mobility difficulty, pain, and disability, it is possible that these factors negatively influence physical activity levels and thereby reduced the influence of physical activity on the SB-anxiety relationship.

4.2. Limitations and future research

The current findings should be interpreted in light of some limitations. First, the study is cross-sectional. The aim of the study therefore only was to quantify the degree to which potentially influential factors in the anxiety-SB relationship may explain this association. Thus, directionality or causality cannot be established and the effect of these influential factors as mediators or confounders cannot be known. Although the current findings provide some potential hypotheses to address the SB and anxiety relationship, longitudinal studies are required to better disentangle the relationships observed here. Second, the anxiety variable used was based on a single question. Although this

question has not been validated before neither post hoc, the use of extreme categories is likely to have improved specificity. Third, SB was captured with a self-report measure, the accuracy of which has been questioned [69, 70]. Future research should utilize objective measures of SB. Accelerometers-inclinometers are available that allow for valid and reliable assessment of SB behavior. However, the association between SB and anxiety may be dependent on the domain/type of SB (e.g., cognitively active SB, such as reading and internet use, versus cognitively passive TV viewing), an aspect that is not reliably measured with accelerometers. Therefore, a combination of both objective and subjective methods is warranted. Fourth, although we adjusted our analyses for employment status, unfortunately, there were no variables in the dataset, which allow for categorization of individuals into those with sedentary jobs and non-sedentary jobs. Nonetheless, the strengths of the study include the large sample size (over 42,000) and the multi-national scope. Most of the research in the domain of SB and anxiety has been conducted in Western countries, and little is known about these experiences and influential factors in LMICs where there are multiple economic, cultural, or social factors or differences in the health systems. Further, the present study was performed with nationally representative samples of non-institutionalized persons. Moreover, by conducting mediation analyses, this study advanced the understanding of factors influencing SB and anxiety in the general population, which to date has largely been missing from the literature.

In conclusion, the current findings support a positive relationship between SB and anxiety. Anxiety was associated with a two-fold elevated odds for highly sedentary behavior. Mobility limitations, pain and discomfort, cognitive problems, sleep and energy issues, and disability may potentially influence the relationship between SB and anxiety; whereas, in older people social cohesion should also be considered. If replicated using longitudinal designs, these findings could offer important new targets and strategies for reducing SB in this vulnerable population.

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Conflict of interest

None to declare from any author.

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Table 1
Characteristics of the study sample

Characteristic		Unweighted N	Overall	Anxiety			Highly sedentary behavior[a]		
				No	Yes	P-value[b]	No	Yes	P-value[b]
Sex	Female	24,137	50.1	49.2	66.6	<0.001	50.1	50.6	0.853
Age (years)	18-49	8,340	72.7	73.5	61.4	<0.001	73.5	64.7	<0.001
	50-64	19,544	17.0	16.7	21.1		17.1	15.8	
	≥65	14,585	10.3	9.8	17.5		9.4	19.6	
	Mean (SD)		43.8 (14.4)	43.6 (14.2)	47.6 (16.5)	<0.001	43.6 (14.0)	46.6 (17.7)	0.022
Wealth	Poorest	7,954	14.9	14.2	27.7	<0.001	15.1	13.2	0.099
	Poorer	8,292	17.8	17.4	24.8		18.0	16.3	
	Middle	8,259	18.8	18.9	18.6		18.7	21.4	
	Richer	8,758	21.1	21.5	15.5		21.7	15.9	
	Richest	9,026	27.3	28.1	13.4		26.6	33.2	
Education	≤Primary	25,451	43.1	41.4	69.8	<0.001	44.1	33.2	0.001
	Secondary	13,231	46.5	47.8	26.8		45.9	51.5	
	≥Tertiary	2,935	10.4	10.9	3.4		10.0	15.2	
Marital status	Married/cohabiting	11,774	80.8	81.3	73.9	<0.001	82.0	72.1	<0.001
Setting	Rural	22,182	55.6	45.1	30.8	<0.001	57.5	37.0	<0.001
Unemployed	Yes	23,778	38.5	37.2	58.5	<0.001	37.5	49.4	<0.001
Physical activity (min)[c]	Mean (SD)		1440 (1500)	1449 (1503)	1302 (1451)	0.038	1480 (1517)	1001 (1237)	<0.001
Alcohol consumption	Yes	7,805	21.9	22.7	8.1	<0.001	21.7	21.2	0.865
Smoking	Yes	11,275	35.2	35.0	37.4	0.305	34.9	36.6	0.617
Body mass index (kg/m^2)	Underweight	5,343	16.8	15.6	38.9	<0.001	17.3	13.3	0.005
	Normal	19,817	55.3	55.9	45.0		55.7	53.1	
	Overweight	9,625	20.9	21.5	9.9		20.5	22.9	
	Obese	5,229	7.0	7.0	6.2		6.6	10.7	
Social cohesion[d]	Mean (SD)		8.6 (4.9)	8.6 (4.8)	8.3 (5.6)	0.274	8.7 (4.9)	7.3 (4.3)	<0.001
Mobility[e]	Mean (SD)		18.0 (23.8)	16.3 (22.2)	47.2 (29.6)	<0.001	17.4 (23.1)	25.3 (29.0)	<0.001
Pain and discomfort[e]	Mean (SD)		19.6 (24.4)	17.7 (22.9)	50.8 (26.9)	<0.001	19.4 (24.1)	23.2 (26.9)	0.021
Cognition[e]	Mean (SD)		16.8 (23.6)	15.4 (22.3)	41.7 (30.8)	<0.001	16.7 (23.2)	19.6 (27.3)	0.056
Sleep and energy[e]	Mean (SD)		17.1 (23.4)	15.3 (21.7)	46.6 (30.5)	<0.001	16.4 (23.0)	24.4 (26.0)	<0.001
Depression	Yes	2,073	5.7	2.5	29.9	<0.001	3.9	5.9	0.014
Disability	Yes	2,440	3.1	2.1	19.2	<0.001	2.6	8.4	<0.001

Abbreviation: SD Standard deviation
Data are column percentage unless otherwise stated.
Estimates are based on weighted sample apart from the unweighted N.
[a] Those spending ≥8 hours per day sedentary were considered to be highly sedentary.
[b] The difference in sample characteristics by anxiety and sedentary behavior was tested by Chi-squared tests and Student's *t*-tests for categorical and continuous variables respectively.

[c] The total amount of moderate-to-vigorous physical activity in a typical week.
[d] Scores ranged from 0 to 36 with higher scores representing higher levels of social cohesion.
[e] Scores ranged from 0 to 100 with higher scores representing worse health status.

Table 2
Association between anxiety and sedentary behavior assessed by multivariable logistic and linear regression (overall and by age groups)

	Logistic regression		**Linear regression**	
	Outcome (high SB[a])		Outcome (min/day of SB)	
Sample	OR	95%CI	b-coefficient	95%CI
Overall[b]	2.04***	[1.54,2.72]	24.16**	[6.95,41.38]
Age 18-49 years[b]	1.72*	[1.02,2.92]	12.10	[-8.62,32.82]
Age 50-64 years[b]	2.47***	[1.65,3.69]	29.54*	[3.59,55.49]
Age ≥65 years[b]	1.91***	[1.43,2.55]	55.08***	[28.92,81.24]

Abbreviation: SB Sedentary behavior; OR Odds ratio; CI Confidence interval
[a] Those reporting ≥8 hours per day spent sedentary were considered to be highly sedentary.
[b] Adjusted for sex, age, wealth, education, marital status, setting, employment status, and country.
* p<0.05, ** p<0.01, *** p<0.001

Table 3

Health status, depression, and disability as mediators in the association between anxiety and highly sedentary behavior (overall and by age groups)

Mediator	Sample	Total effect	P-value	Direct effect	P-value	Indirect effect	P-value	% Mediated
Mobility	Overall	2.05 [1.51,2.77]	<0.001	1.46 [1.05,2.04]	0.025	1.40 [1.25,1.57]	<0.001	46.8
	Age 18-49 years	1.71 [1.00,2.94]	0.052	1.32 [0.73,2.39]	0.365	1.30 [1.07,1.58]	0.009	48.8
	Age 50-64 years	2.50 [1.64,3.80]	<0.001	1.83 [1.17,2.87]	0.008	1.36 [1.23,1.52]	<0.001	33.8
	Age ≥65 years	2.03 [1.50,2.74]	<0.001	1.32 [0.98,1.78]	0.069	1.54 [1.36,1.74]	<0.001	60.8
Pain and discomfort	Overall	2.02 [1.51,2.71]	<0.001	1.62 [1.18,2.22]	0.003	1.25 [1.13,1.39]	<0.001	31.7
	Age 18-49 years	1.70 [1.00,2.87]	0.049	1.44 [0.81,2.54]	0.212	1.18 [0.98,1.42]	0.075	NA
	Age 50-64 years	2.44 [1.61,3.72]	<0.001	1.97 [1.29,2.99]	0.002	1.24 [1.12,1.38]	<0.001	24.4
	Age ≥65 years	1.95 [1.45,2.62]	<0.001	1.36 [1.02,1.82]	0.039	1.43 [1.28,1.60]	<0.001	54.0
Cognition	Overall	2.03 [1.52,2.71]	<0.001	1.85 [1.37,2.49]	<0.001	1.10 [1.03,1.18]	0.008	13.3
	Age 18-49 years	1.72 [1.01,2.93]	0.045	1.85 [1.08,3.17]	0.024	0.93 [0.80,1.08]	0.328	NA
	Age 50-64 years	2.44 [1.61,3.70]	<0.001	2.01 [1.32,3.05]	0.001	1.22 [1.13,1.32]	<0.001	22.0
	Age ≥65 years	1.93 [1.44,2.58]	<0.001	1.46 [1.08,1.97]	0.013	1.32 [1.21,1.44]	<0.001	42.4
Sleep and energy	Overall	1.99 [1.47,2.69]	<0.001	1.46 [1.05,2.04]	0.025	1.36 [1.19,1.56]	<0.001	44.9
	Age 18-49 years	1.64 [0.94,2.87]	0.083	1.16 [0.63,2.12]	0.635	1.42 [1.15,1.74]	0.001	70.4
	Age 50-64 years	2.46 [1.64,3.70]	<0.001	1.94 [1.28,2.93]	0.002	1.27 [1.13,1.42]	<0.001	26.4
	Age ≥65 years	1.94 [1.45,2.60]	<0.001	1.56 [1.17,2.08]	0.003	1.25 [1.13,1.38]	<0.001	33.3
Depression	Overall	1.99 [1.48,2.68]	<0.001	1.78 [1.29,2.46]	0.001	1.12 [1.00,1.25]	0.050	NA
	Age 18-49 years	1.60 [0.92,2.79]	0.095	1.35 [0.73,2.51]	0.337	1.18 [0.96,1.46]	0.117	NA
	Age 50-64 years	2.46 [1.64,3.69]	<0.001	2.31 [1.53,3.49]	<0.001	1.06 [0.97,1.17]	0.210	NA
	Age ≥65 years	1.91 [1.43,2.54]	<0.001	1.75 [1.30,2.36]	<0.001	1.09 [0.99,1.19]	0.075	NA
Disability	Overall	1.93 [1.42,2.62]	<0.001	1.61 [1.17,2.24]	0.004	1.19 [1.12,1.27]	<0.001	27.0
	Age 18-49 years	1.65 [0.96,2.82]	0.068	1.40 [0.79,2.48]	0.245	1.17 [1.05,1.31]	0.005	32.2
	Age 50-64 years	2.47 [1.64,3.71]	<0.001	2.29 [1.50,3.51]	<0.001	1.08 [1.02,1.14]	0.013	8.1
	Age ≥65 years	1.85 [1.35,2.53]	<0.001	1.43 [1.04,1.97]	0.029	1.30 [1.18,1.42]	<0.001	42.1

Data are odds ratio [95% confidence interval].

Models are adjusted for sex, age, wealth, education, marital status, setting, employment status, and country.

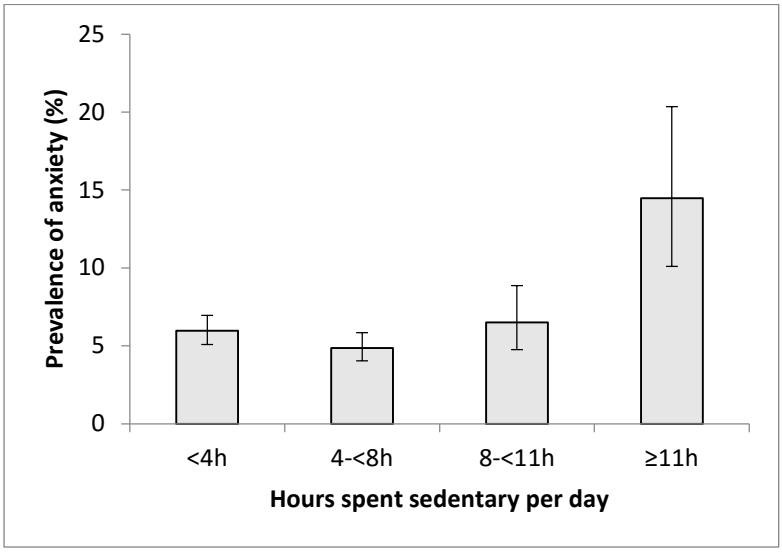
The mediated percentage was calculated only when the indirect effect was significant (P<0.05).

Table 4
Physical activity, alcohol consumption, smoking, body mass index, and social cohesion as influential factors in the association between anxiety and highly sedentary behavior

Influential factor	Sample	Total effect	P-value	Direct effect	P-value	Indirect effect	P-value	% Mediated
Physical activity	Overall	2.11 [1.57,2.82]	<0.001	2.01 [1.49,2.70]	<0.001	1.05 [1.01,1.09]	0.025	6.3
	Age 18-49 years	1.76 [1.04,3.00]	0.036	1.69 [0.99,2.88]	0.055	1.05 [0.99,1.10]	0.115	NA
	Age 50-64 years	2.51 [1.65,3.82]	<0.001	2.46 [1.61,3.77]	<0.001	1.02 [0.99,1.05]	0.180	NA
	Age ≥65 years	1.97 [1.47,2.64]	<0.001	1.91 [1.42,2.58]	<0.001	1.03 [0.96,1.10]	0.418	NA
Alcohol consumption	Overall	2.05 [1.54,2.74]	<0.001	2.06 [1.54,2.76]	<0.001	0.99 [0.98,1.01]	0.348	NA
	Age 18-49 years	1.73 [1.02,2.93]	0.041	1.74 [1.03,2.94]	0.040	1.00 [0.98,1.01]	0.735	NA
	Age 50-64 years	2.46 [1.63,3.71]	<0.001	2.45 [1.62,3.69]	<0.001	1.01 [0.99,1.02]	0.370	NA
	Age ≥65 years	1.92 [1.44,2.57]	<0.001	1.92 [1.44,2.56]	<0.001	1.00 [0.99,1.01]	0.768	NA
Smoking	Overall	2.05 [1.54,2.74]	<0.001	2.02 [1.52,2.70]	<0.001	1.01 [1.00,1.03]	0.149	NA
	Age 18-49 years	1.74 [1.02,2.95]	0.041	1.72 [1.01,2.91]	0.045	1.01 [0.98,1.04]	0.465	NA
	Age 50-64 years	2.48 [1.65,3.71]	<0.001	2.46 [1.64,3.69]	<0.001	1.01 [0.99,1.02]	0.470	NA
	Age ≥65 years	1.92 [1.43,2.57]	<0.001	1.91 [1.43,2.56]	<0.001	1.00 [0.99,1.01]	0.892	NA
Body mass index (kg/m^2)	Overall	2.05 [1.51,2.78]	<0.001	2.04 [1.50,2.79]	<0.001	1.00 [0.97,1.03]	0.893	NA
	Age 18-49 years	1.77 [1.05,3.00]	0.033	1.78 [1.05,3.03]	0.032	0.99 [0.96,1.03]	0.675	NA
	Age 50-64 years	2.43 [1.60,3.71]	<0.001	2.42 [1.56,3.75]	<0.001	1.00 [0.96,1.05]	0.836	NA
	Age ≥65 years	1.96 [1.41,2.72]	<0.001	1.94 [1.40,2.68]	<0.001	1.01 [0.98,1.04]	0.620	NA
Social cohesion	Overall	2.03 [1.51,2.72]	<0.001	1.99 [1.49,2.67]	<0.001	1.02 [1.00,1.04]	0.090	NA
	Age 18-49 years	1.71 [1.00,2.91]	0.050	1.69 [0.99,2.88]	0.054	1.01 [0.99,1.03]	0.371	NA
	Age 50-64 years	2.47 [1.66,3.69]	<0.001	2.45 [1.64,3.65]	<0.001	1.01 [0.98,1.04]	0.465	NA
	Age ≥65 years	1.93 [1.45,2.56]	<0.001	1.81 [1.35,2.43]	<0.001	1.06 [1.02,1.11]	0.005	9.5

Data are odds ratio [95% confidence interval].
Models are adjusted for sex, age, wealth, education, marital status, setting, employment status, and country.
The mediated percentage was calculated only when the indirect effect was significant (P<0.05).

Figure 1 Prevalence of anxiety by hours of sedentary behavior per day



Estimates are based on a weighted sample.
Bars denote 95% confidence intervals.

Highlights

- Individuals with anxiety have a two-fold higher odds for being sedentary for more than 8 hours per day.
- Mobility difficulties, sleep problems, pain and disability are important factors contributing to the sedentary behavior of people with anxiety.